The Future of Terminal Airspace: An Airportal for 2025

ICNS Conference
May 2006
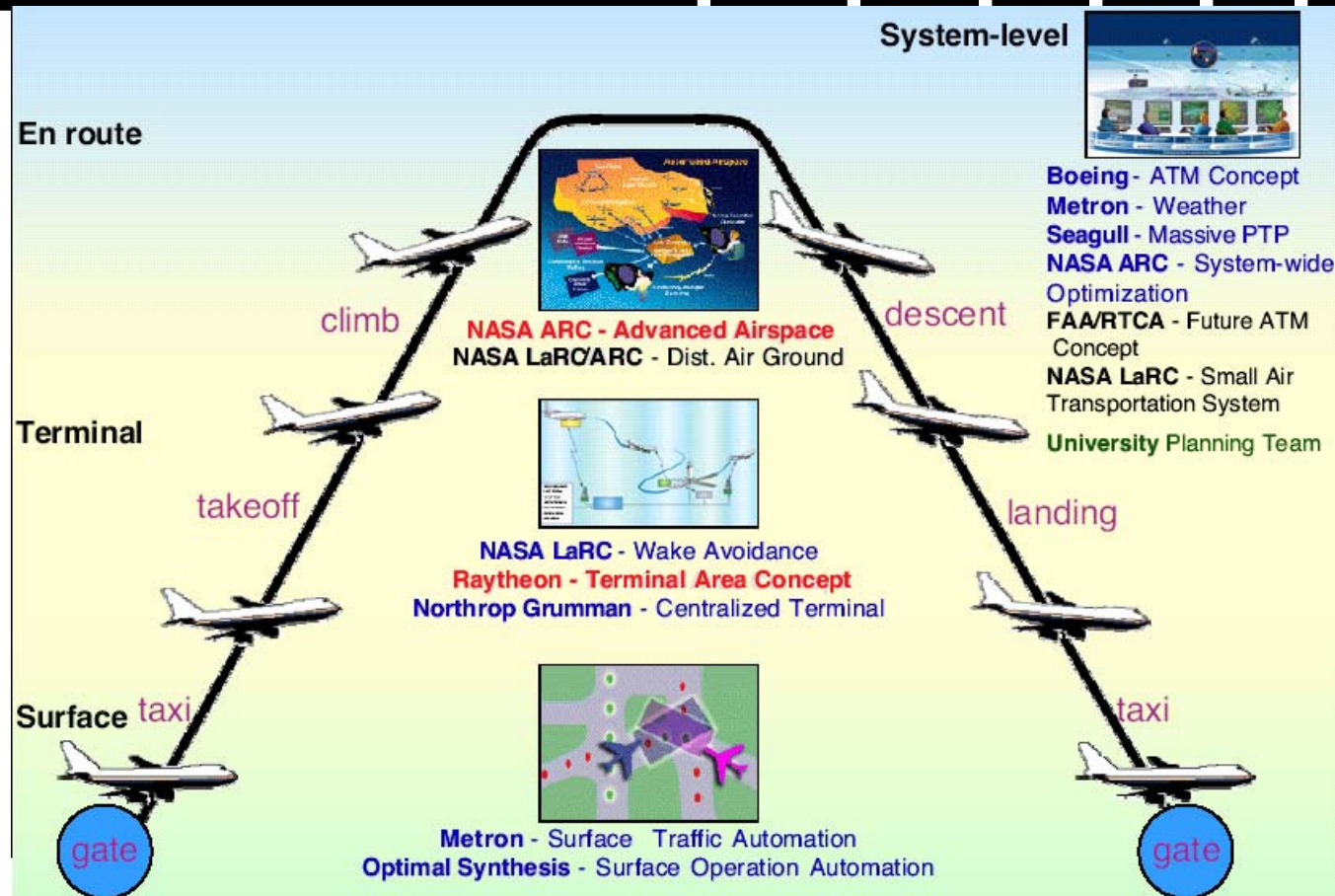
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Agenda

- **Virtual Airspace Modeling and Simulation (VAMS) Overview**

- **Terminal Domain Concepts and Core Ideas**

- **Blended Terminal Domain Concept**

VAMS Future Concepts

NASA VAMS Multi-Year Research and Technology Development Project
- Develop Capacity Increasing Concepts targeted for 2020/2025
- Enable throughput increases of 100% based on 1997 levels
- Raytheon supporting VAMS under a Space Act Agreement

VAMS Domains and Concepts

SLIC CONCEPT		Surface (ATCT)	Terminal (TRACON)	En Route (ARTCC)	National (ATCSCC/AOC)
1	SWO			⬭	
2	SOAR	⬭			
3	PTP	⬭			
4	AAC		⬭		
5	Metron Surface	⬭			
6	TACEC	⬭			
7	Metron Weather	⬭			
8	WVAS	⬭			
9	University Concepts	⬭			

- System Wide Optimization (SWO)
- Surface Operation Automation Research (SOAR)
- Point-to-Point and On Demand Air Transportation System (PTP)
- Advanced Airspace Concept (AAC)
- Metron Surface
- Terminal Airspace Capacity Enhancing Concept (TACEC)
- Metron Weather
- Wake Vortex Avoidance System Concept (WVAS)
- University Concept (Optional Tube Concept)

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Terminal Domain Core Ideas

- **Terminal Airspace**
  - "Metroplex" Includes both Major/Hub and Regional Airports

- **Automation Integrates Planning & Control of Air and Surface Domains**
  - Dynamically allocates meter fix (anchor points) to optimize weather/demand
  - Services aircraft based on level of equipage

- **Very Closely Spaced Parallel Runway (VCSPR) Operation**
  - Enables airports with existing VCSPR to operate in both IMC and VMC
  - Allows construction of additional runways within existing airport footprint

- **Automation-Enhanced Regional Airports**
  - Enables increased Point-to-Point operation
  - Reduces congestion at Hub airports

- **Reduced In-Trail Wake Vortex Spacing**
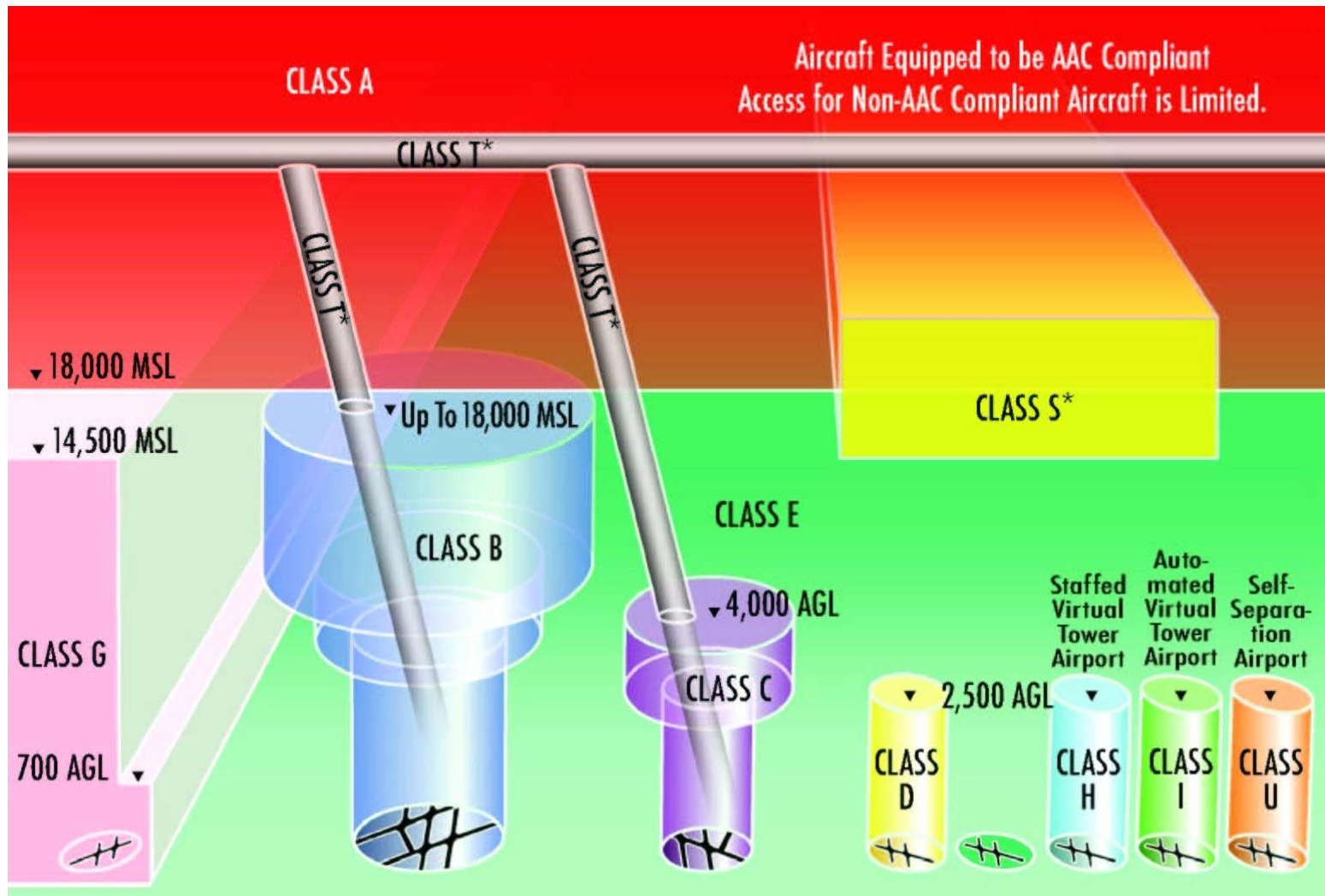
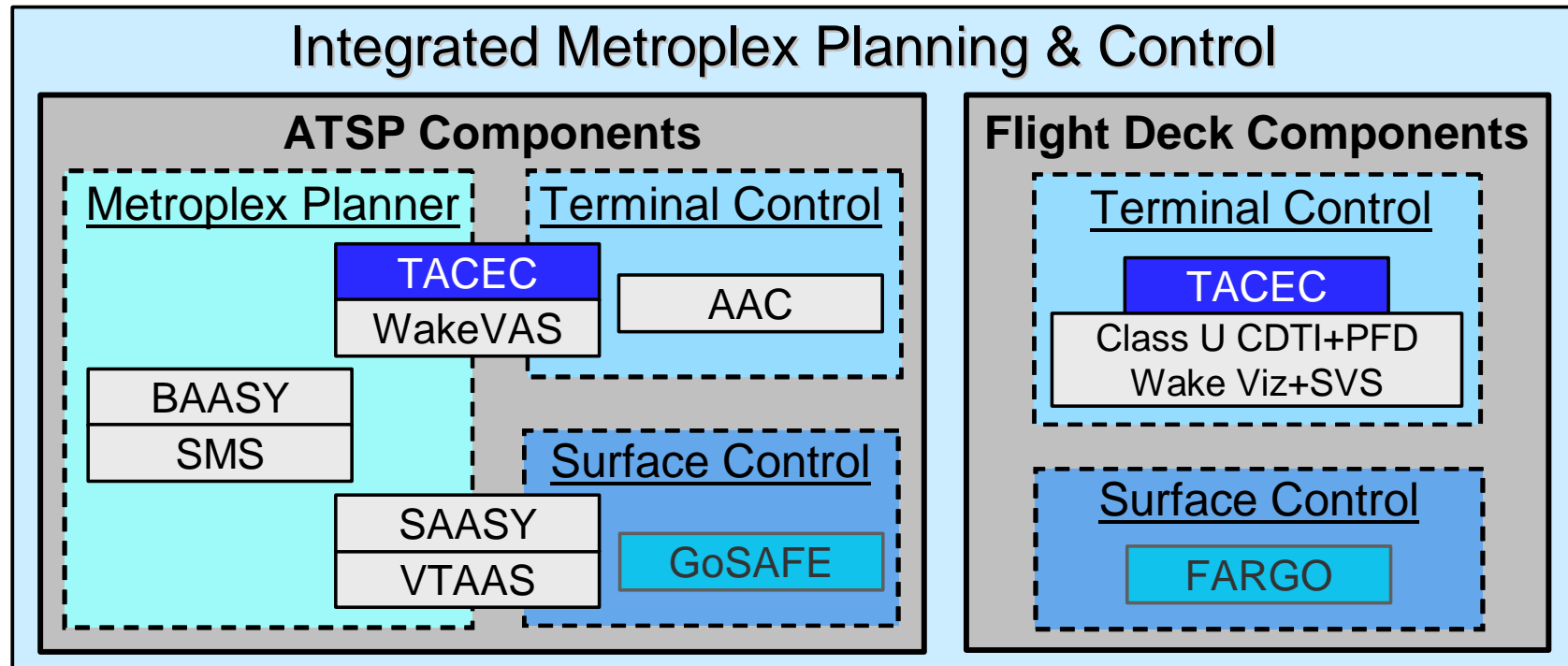# Airspace Class Equipage Levels

- **Class A: Fully AAC equipped (including CPDLC, 4DFMS, ADS-X Mode S transponder)**

- **Class B: Fully AAC equipped (including CPDLC, 4DFMS, ADS-X Mode S transponder)**

- **Class C/D/E/H/I: Allow set number of non-AAC equipage within given airspace volume (sector)**

- **Class G: "see and avoid"**

- **Class U: Fully Class U equipped (CPDLC, 4DFMS, ADS-X Mode S transponder, TIS-X receiver, FIS-X receiver, MFD/CDTI, PFD Wake Visualization, Sensor Enhanced-Synthetic Vision System)**

Integrated Planning & Control Components

Integrated Metroplex Planning & Control

ATSP Components

Metroplex Planner

TACEC

WakeVAS

BAASY

SMS

SAASY

VTAAS

Terminal Control

AAC

Surface Control

GoSAFE

Flight Deck Components

Terminal Control

TACEC

Class U CDTI+PFD
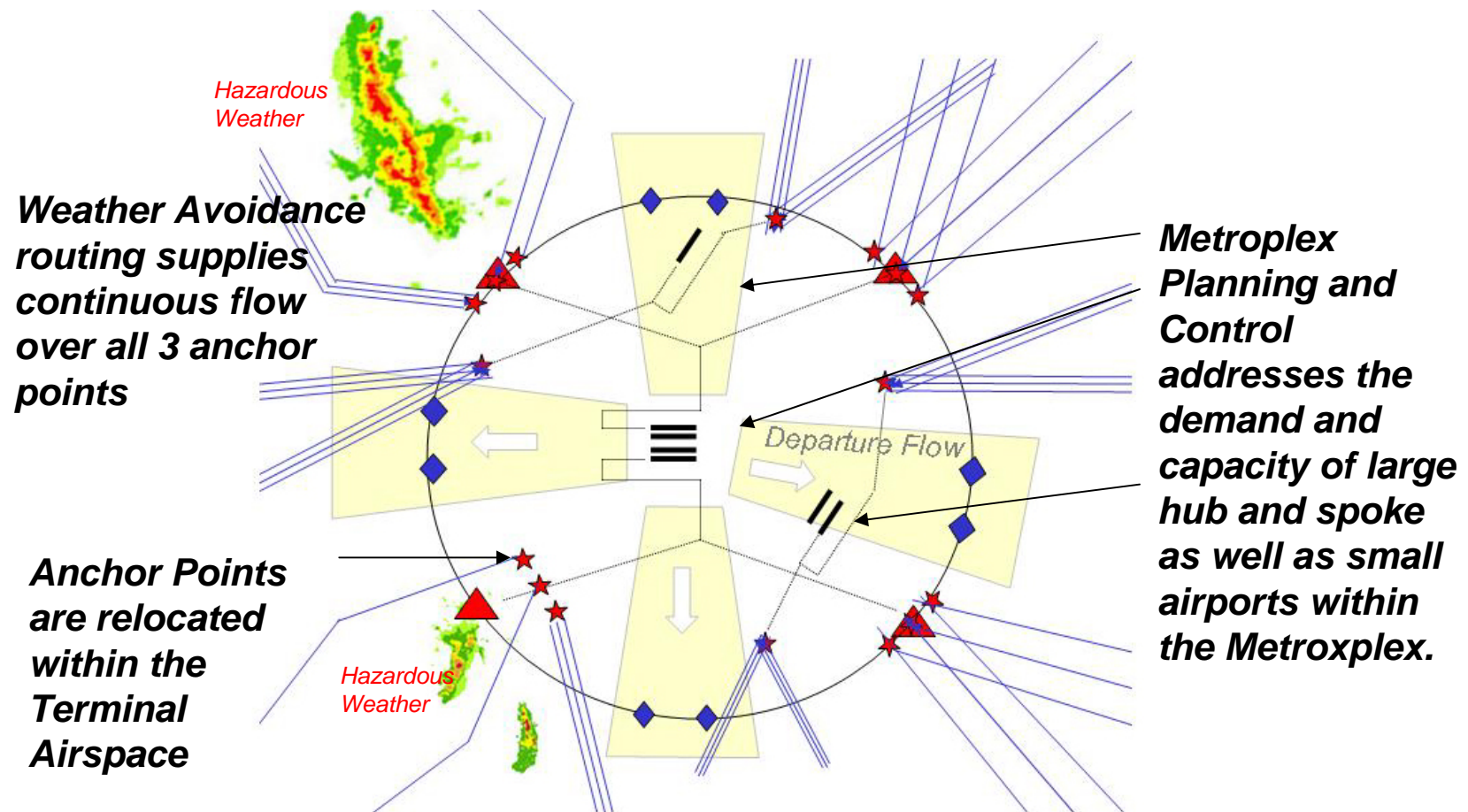Wake Viz+SVS

Surface Control

FARGO

PTP Automation
- Basic Airport Automation System (BAASY) - Class U Airspace
- Smart Airport Automation System (SAASY) - Class I Airspace
- Virtual Tower Airport Automation System (VTAAS) - Class H Airspace

Hazardous Weather

Weather Avoidance routing supplies continuous flow over all 3 anchor points

Anchor Points are relocated within the Terminal Airspace

Hazardous Weather

Departure Flow

Metroplex Planning and Control addresses the demand and capacity of large hub and spoke as well as small airports within the Metroxplex.

Equipage-based Service

Aircraft are assigned arrival/departure rates based on their level of equipage

RNP-4
Requirement

RNP-2
Requirement

All Aircraft
Accepted

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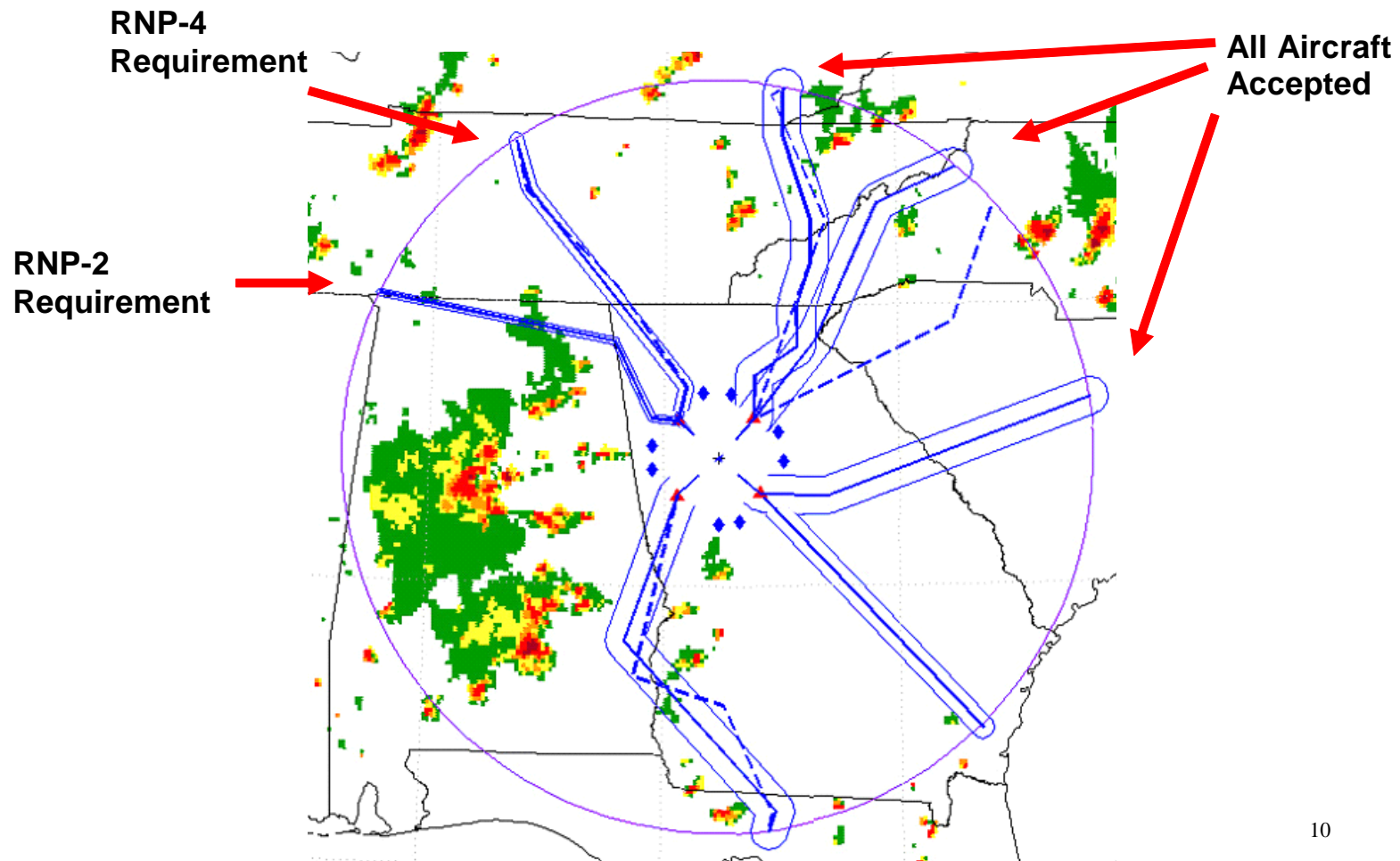
Very Closely Spaced Runway Operations

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Network Centric Systems

Staging Arrivals

- Metroplex Planning and Control
- AAC Uplinks 4D Trajectories
- 4D FMS with uncoupled autopilots

Final Approach

- LAAS/ILS Auto-land thru Cat III
- Follower Coupled to Lead with ADS-X

t_D

C_{error}

CSPRs
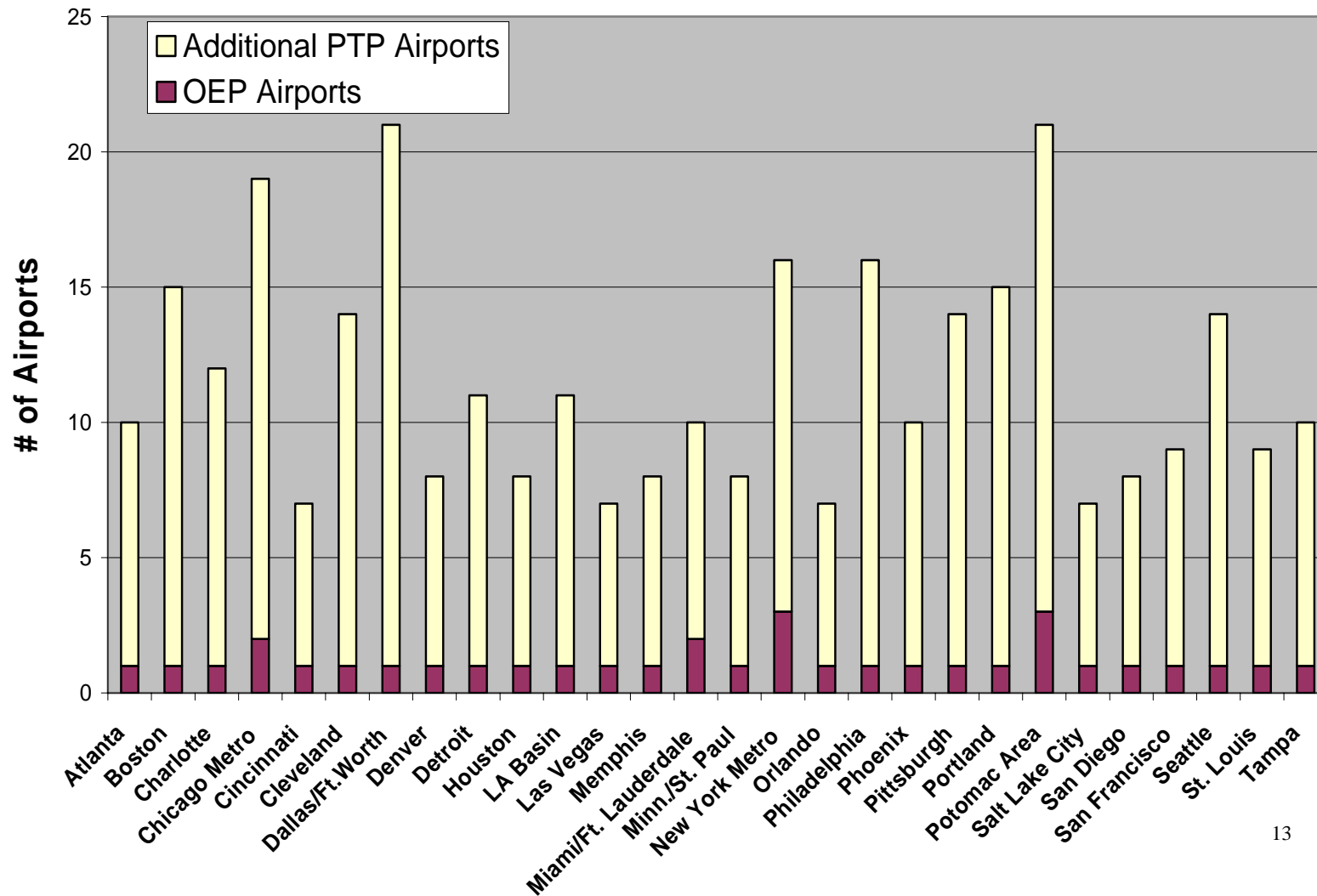
Enhanced CNS and Automation Enable SuperDensity and VMC in IMC

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Network Centric Systems

Many Public-Use Airports Available within 30 nm of OEP Airports

Automation-Enhanced Regional Airports

**Staffed Virtual Tower Airport**

Class H

Staffed Virtual Tower Separation Assurance

- **Separation assurance from remote virtual tower controller staff using:**
  - **Electronic surveillance and VHF radio or Datalink**
- **Access for all aircraft with Mode C transponder and VHF radio**

Automated Virtual Tower Airport

Class I

Automated Virtual Tower Separation Assurance

- **Automated separation assurance from ground-based automation system using:**
  - **Voice Synthesis and Datalink**
- **Access for all aircraft with Mode C transponder and VHF radio**

Self-Separation Airport

Class U

CDTI

CDTI

Automated Sequencing

Self-Separation and Merging
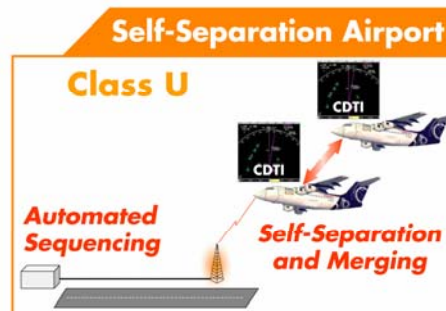
- **Aircraft self-separation and self-merging using:**
  - **ADS-B, CDTI, Synthetic Vision with Vortex Prediction**
- **Ground-based automated sequencing**
- **Access restricted to highly-equipped aircraft**

Reduced In-Trail Wake Vortex Spacing

Ground-based wake vortex sensors, advanced data fusion/weather prediction, and improved aircraft position and intent data enable reduced longitudinal wake vortex spacing
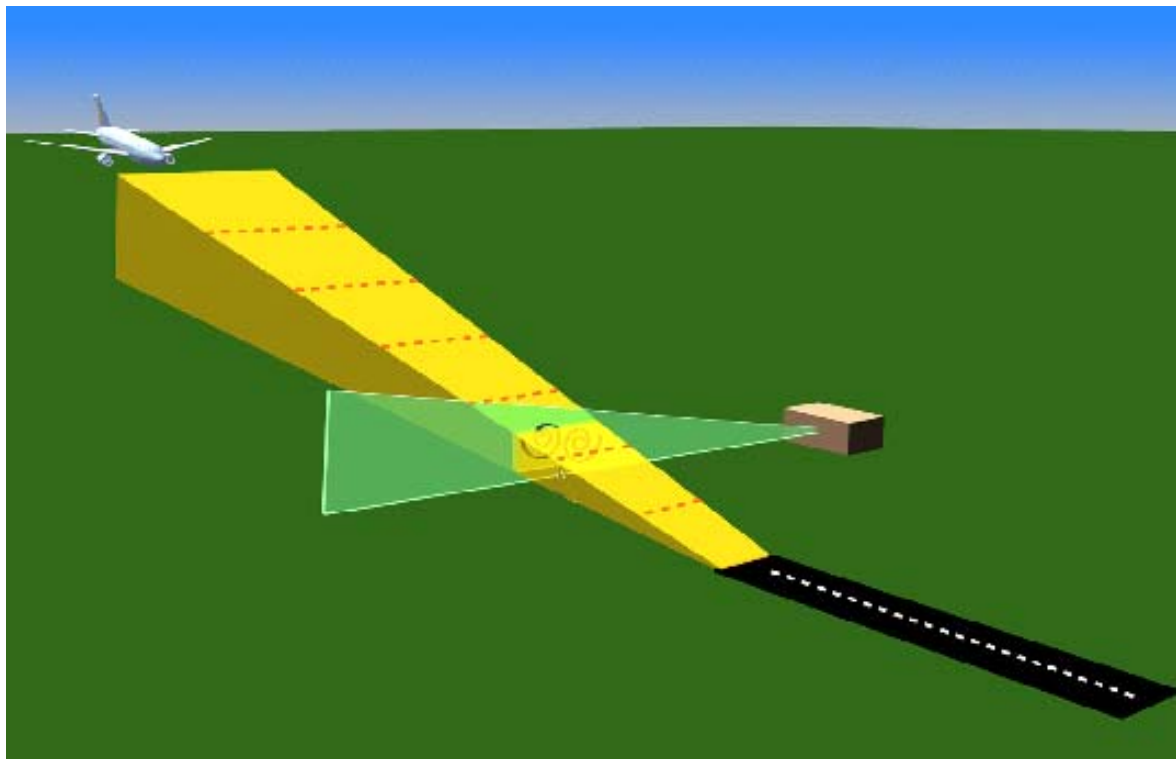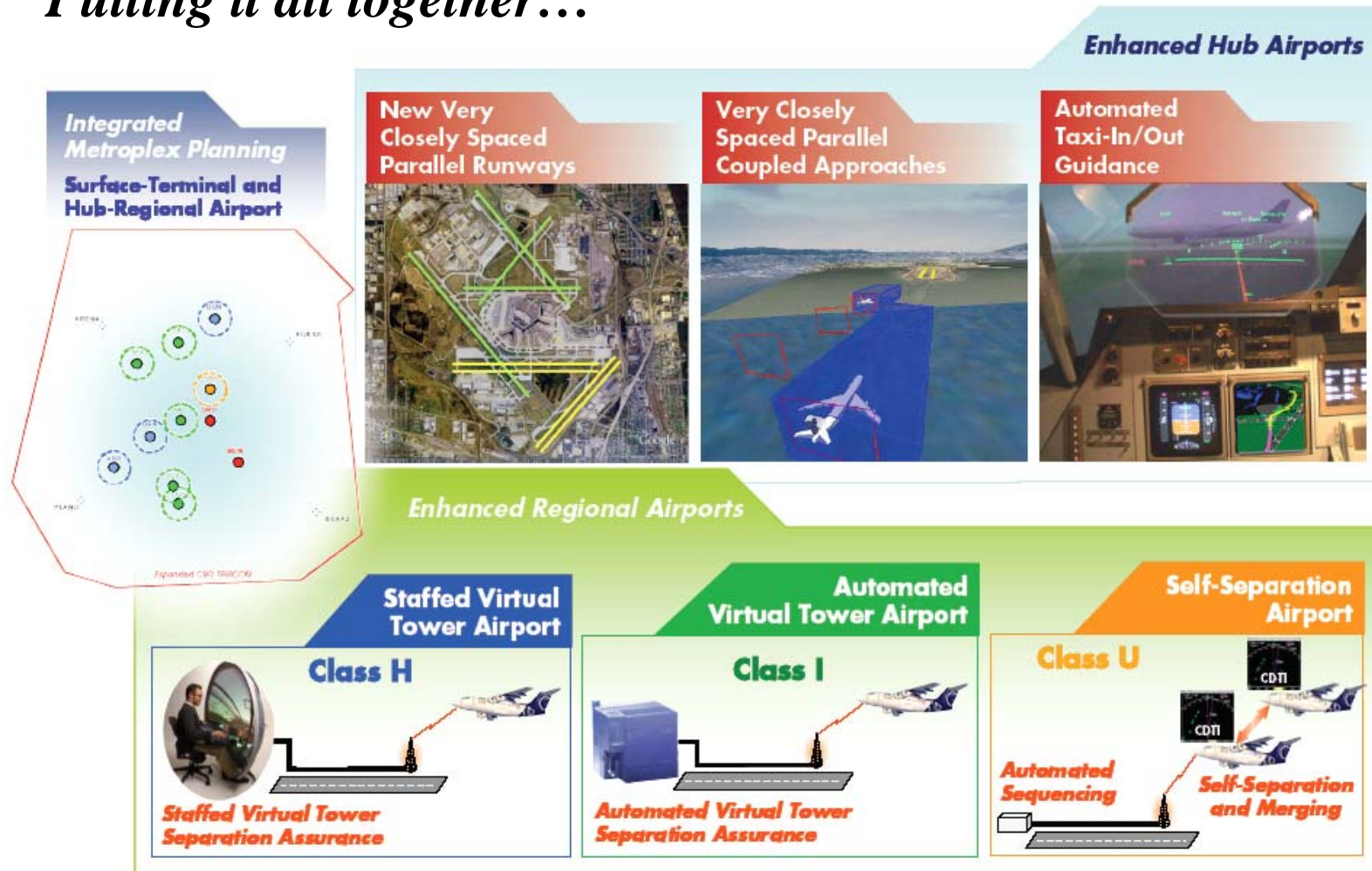
Putting it all together…

Questions?